

# Petr Stepanov

Materials science. Gamma spectroscopy. Positron spectroscopy.

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## Objective

Ph.D. graduate with expertise in gamma spectroscopy, positron annihilation spectroscopy, microscopy, and nuclear physics. Strong background in computational techniques, desktop software development and web applications. More than five years in user interface and user experience design.

Graduated from [BGSU](#) in May 2020. Seeking to either become an effective member of a research group in the industry. Authorized to work in the US on [Optional Practical Training \(OPT\)](#) in the following areas: physics, chemistry, and computer science. Will consider [visa sponsorship \(H1B\)](#) offers.

## Work experience

### Research Collaborator

Jul 2020 – Current

*Thomas Jefferson National Accelerator Facility (JLab), Newport News, VA USA*

- Applied CERN ROOT framework (C++) to perform statistical analysis of a significant amount (over 100 GB) of the raw experimental data of the [Kaon LT](#) experiment at JLab. [Link to GitHub](#).
- Utilized SLURM environment on [JLab supercomputer environment](#) to run resourceful particle simulations on multiple computing nodes at the same time. This decreased the wall computation time by more than 10 times.
- Proposed and implemented RAMDisk functionality on the development environment. This led to an over 60% increase in source code indexing time.

### Postdoctoral Researcher

Jul 2020 – Current

*Catholic University of America (CUA), Washington, DC, USA*

- Developed a computer simulation based on the Geant4 framework (C++, CMake, Eclipse IDE, gdb) to study optical properties of a novel scintillation material to be used in the EIC detector system. [Link to GitHub repository](#).
- Teaching experience: mentoring students within a 3-month Research Experiences for Undergraduates (REU) program at the Physics Department at CUA. Giving talks and presentations about [Linux Terminal](#), and [supercomputer environment](#).
- Enhanced debugging of the core library source code led to opening more than [10 bug reports](#) on the ROOT (C++) forum.

### Research Assistant

Aug 2014 – May 2020

*[Bowling Green State University \(BGSU\)](#), Bowling Green, OH, USA*

- Applied ROOT C++ libraries to write four GUI software for scientific data interpretation.
  - GitHub repositories contain over 10k lines of code in total: [TLIST Processor](#), [SW Calculator](#), [RooPositron](#), [LuminApp](#).
  - Technologies used: CMake, C++, ROOT, Fox GUI and RooFit libraries. Java and Swing.
- Developed static website (Hexo, Gulp, Bootstrap) and visual identity for the [SelimLab](#) research group. Website has a 99% Google performance rank and features 700 ms time to interactive metrics.
- Maintained local Apache HTTP server [physics.bgsu.edu](http://physics.bgsu.edu) hosting over 10 websites at the BGSU.
- Created [website for the ICPA-18 international conference](#) with registration (over 150 users) and payment system workflow (WordPress, PHP, Recurly.js), and [landing pages for events](#).

### Frontend Developer, Freelance UI/UX Designer

Aug 2014 – Current

- Built an online e-commerce store [Sticker Store LLC](#) with static website generator (Hexo, Snipcart, Bootstrap, SASS, EJS, Node.js).
  - Improved the Google PageSpeed Insights metrics (CLS, LCP) up to 97%.
  - Created a recursive script to export over 300 products from YAML file to Google Merchant.
  - Optimized SEO. Project reached over 1400 organic monthly users.

- Made iOS application (Swift, UIKit, storyboards) for the [We.Team](#) messenger (more than 3k monthly downloads in AppStore). Participated in cloud-based messenger development with enhanced file sharing capabilities (HTML, React JS, SASS).
- Migrated the landing page for [Sweetbridge](#) company from WordPress to Jekyll static site generator (Ruby, CSS). This resulted in a 70% improvement in the page load time.
- Developed the front-end part (Angular.js, HTML, LESS) for [Lili Social](#) network.
  - Assisted with iOS mobile application (Ionic).
  - Enabled SEO crawling of over 1000 Angular.js pages with Google bot.
- *Web design.*
  - Designed logos, UI/UX prototypes (Figma, Sketch, Illustrator) and branding identity for over [10 different companies](#).
  - Converted numerous design assets and mockups into responsive HTML and CSS.
  - Mocked up and integrated dozens of cross-browser responsive email templates.

## Full Stack Web Developer

Apr 2011 – Aug 2014

[Gridnine Systems](#), Moscow, Russia

- Responsible for the front-end development of the [ATH American Express](#) – the largest travel management company in Russia (JavaScript, Backbone.js, and RequireJS). Increased the front-end load time by over 30%.
- Utilized Google Web Toolkit (GWT) Model-View-Presenter (MVP) framework to develop frontend for [Otixo](#) cloud file integrator (JavaScript, CSS, responsive design).
- Implemented image processing servlets on the backend to generate banners for five different social networks (PHP, ImageMagic).
- Prototyping conceptual wireframes and UI/UX mockups for numerous web applications (Adobe Creative Suite).

## Computer Science Teacher

Oct 2009 – May 2011

*Phys-Tech College at Moscow Institute of Physics and Technology (MIPT), Moscow, Russia*

- Provided instruction and guidance to high school students on following computer courses: advanced C++ programming, markup on the web, Photoshop and 3D Studio Max.

## Research Scientist

Sep 2008 – Apr 2011

*Institute for Theoretical and Experimental Physics (ITEP), Moscow, Russia*

Application of positron lifetime spectroscopy for studying the radioactive-induced defects in steels. Monte-Carlo particle simulations with Fortran 95. Maintaining software for CAMECA tomographic atom probe (MSVC). Application of CERN ROOT libraries for fitting and analysis of experimental spectra.

# Education

## Bowling Green State University

Aug 2014 – May 2020

*Bowling Green, OH, USA*

Doctor of Philosophy (Ph.D.) in photochemical sciences. GPA 3.423. Dissertation topic: New developments in positron annihilation spectroscopy techniques—from experimental setups to advanced processing software. [View dissertation manuscript](#).

Under the guidance of Dr. Selim I have successfully assembled and maintained two positron spectrometers (Doppler and lifetime) from ORTEC and Canberra units. The research was aimed at the application of Doppler and lifetime positron spectroscopy techniques to study following topics:

- Localization of the positrons (e+) in defects.
- Grain sizes in solids.
- Kinetics of positrons and positronium atoms in nano-powders.
- Oxidation and ortho-para conversion of positronium atoms in liquids.

Single-photon counting techniques with High-Purity Germanium Detectors (HPGe) and scintillation-based detector systems. Preparing sources of positron radiation and inventorying the radioactive materials.

Additionally, a number of open-source desktop GUI software solutions for fitting and interpretation of the raw positron experimental spectra. Software is written in C++ and extensively utilized the CERN ROOT and RooFit frameworks.

## British Higher School of Art and Design

Dec 2011 – Feb 2012

*Moscow, Russia*

Three-month intensive on [graphical design and visual communications](#).

## Recent publications

- J Arrington, CA Gayoso, PC Barry, V Berdnikov, D Binosi, L Chang et. al. Revealing the structure of light pseudoscalar mesons at the electron–ion collider. *Journal of Physics G: Nuclear and Particle Physics* 48 (7), 075106. DOI: [10.1088/1361-6471/abf5c3](https://doi.org/10.1088/1361-6471/abf5c3)
- Stepanov, P. S.; Selim, F. A.; Stepanov, S. V.; Bokov, A. V.; Ilyukhina, O. V.; Duplâtre, G.; Byakov, V. M. Interaction of positronium with dissolved oxygen in liquids. *Physical Chemistry Chemical Physics* **2020**. DOI: [10.1039/C9CP06105C](https://doi.org/10.1039/C9CP06105C)
- Stepanov, P. S.; Selim, F. A.; Stepanov, S. V.; Byakov, V. M. A Model for Joint Processing of LT and CDB Spectra of Dielectric Nano-sized Powders. *AIP Conference Proceedings* **2019**, 2182 (1), 040004. DOI: [10.1063/1.5135836](https://doi.org/10.1063/1.5135836)
- Stepanov, P. S.; Selim, F. A.; Stepanov, S. V.; Byakov, V. M. Positron and positronium in Al<sub>2</sub>O<sub>3</sub> nanopowders. *AIP Conference Proceedings* **2019**, 2182 (1), 050008. DOI: [10.1063/1.5135851](https://doi.org/10.1063/1.5135851)
- Zhang, L.; Wu, J.; Stepanov, P.; Haseman, M.; Zhou, T.; Winarski, D.; Saadatikia, P.; Agarwal, S.; Selim, F. A.; Yang, H.; et al. Defects and solarization in YAG transparent ceramics. *Photonics Research* **2019**, 7 (5), 549 DOI: [10.1364/prj.7.000549](https://doi.org/10.1364/prj.7.000549)
- Saadatikia, P.; Stepanov, P.; Selim, F. A. Photoconductivity of bulk SrTiO<sub>3</sub> single crystals at room temperature. *Materials Research Express* **2018**, 5 (1), 016202 DOI: [10.1088/2053-1591/aaa094](https://doi.org/10.1088/2053-1591/aaa094)
- Stepanov, S.; Byakov, V.; Duplâtre, G.; Stepanov, P.; Bokov, A. Track Effects in Positronium Formation. *Acta Physica Polonica A* **2017**, 132 (5), 1461–1466 DOI: [10.12693/aphyspola.132.1461](https://doi.org/10.12693/aphyspola.132.1461)
- Stepanov, P.; Stepanov, S.; Byakov, V.; Selim, F. Developing New Routine for Processing Two-Dimensional Coincidence Doppler Energy Spectra and Evaluation of Electron Subsystem Properties in Metals. *Acta Physica Polonica A* **2017**, 132 (5), 1628–1633 DOI: [10.12693/aphyspola.132.1628](https://doi.org/10.12693/aphyspola.132.1628)
- Ji, J.; Colosimo, A. M.; Anwand, W.; Boatner, L. A.; Wagner, A.; Stepanov, P. S.; Trinh, T. T.; Liedke, M. O.; Krause-Rehberg, R.; Cowan, T. E.; et al. ZnO Luminescence and scintillation studied via photoexcitation, X-ray excitation and gamma-induced positron spectroscopy. *Scientific Reports* **2016**, 6 (1), 31238 DOI: [10.1038/srep31238](https://doi.org/10.1038/srep31238)
- Stepanov, S. V.; Byakov, V. M.; Zvezhinskiy, D. S.; Duplâtre, G.; Dubov, L. Y.; Stepanov, P. S.; Perfiliev, Y. D.; Kulikov, L. A. Premelting as studied by positron annihilation and emission Mössbauer spectroscopies. *Journal of Physics: Conference Series* **2016**, 674, 012018 DOI: [10.1088/1742-6596/674/1/012018](https://doi.org/10.1088/1742-6596/674/1/012018)
- Colosimo, A. M.; Ji, J.; Stepanov, P. S.; Boatner, L. A.; Selim, F. A. Scintillation of Un-doped ZnO Single Crystals. *MRS Advances* **2016**, 1 (2), 121–126 DOI: [10.1557/adv.2015.60](https://doi.org/10.1557/adv.2015.60)
- Stepanov, S. V.; Byakov, V. M.; Duplâtre, G.; Zvezhinskiy, D. S.; Stepanov, P. S.; Zaluzhnyi, A. G. Early processes in positron and positronium chemistry: possible scavenging of epithermal e by nitrate ion in aqueous solutions. *Journal of Physics: Conference Series* **2015**, 618, 012003 DOI: [10.1088/1742-6596/618/1/012003](https://doi.org/10.1088/1742-6596/618/1/012003)
- Stepanov, P. S.; Byakov, V. M.; Zaluzhnyi, A. G. The use of positron spectroscopy for revealing the nanosized structures in liquid mixtures. Identification of n-propanol nanoagglomerates in aqueous solutions. *Russian Journal of Physical Chemistry A* **2014**, 88 (4), 685–690 DOI: [10.1134/s003602441404027x](https://doi.org/10.1134/s003602441404027x)

A complete list of publications is posted on my [Google Scholar page](#).

## Material Research Skills

### Characterization facilities

Positron Lifetime and Doppler Broadening Annihilation Spectroscopy (PALS, DBAR). Atom Probe Tomography (ATP). Scanning Electron Microscopy (SEM). Transmission electron microscopy (TEM). Atomic Force Microscopy (AFM). UV-VIS Spectroscopy. Fourier Transform Infrared Spectroscopy (FTIR).

### Material processing

High-temperature annealing. Wet chemical etching. Electrical Contact Fabrication. Sample polishing.

# Computer Skills

## Software

Scientific packages: Wolfram Mathematica, Maple.

Markup: LaTeX, MS Office Suite, Zotero.

Data plotting: OriginLab, Gnuplot, QtiPlot, SciDaVis, Grapher, Adobe Products.

## Desktop development

Java and Swing, C/C++ and Qt, GNU Automake, CERN ROOT, Geant4, PHP, Fortran.

## UI/UX design

Figma, Sketch, InVision Studio, Adobe XD, Adobe Photoshop, Adobe Illustrator, Inkscape, Blender.

## Frontend

HTML, CSS (LESS and SASS), Bootstrap, responsive web design, JavaScript and jQuery, npm, gulp, CommonJS, AngularJS, React.js and Backbone.js. Google Web Toolkit. WordPress themes development.

# Scientific programs

Multiple desktop software for simulation, data analysis and spectra interpretation are developed. The scientific libraries of my choice are [CERN ROOT](#) and [Geant4](#) frameworks. ROOT offers numerous packages for histogram manipulation, fitting and plotting as well as data storage and graphical user interface (GUI) classes.

## Glass Prototype

A Geant4-based simulation that studies performance of a novel scintillation material “SciGlass”. Simulation can reconstruct the detector response from interaction of the detector with high energy ionizing particles. Contributions of the scintillation and Cherenkov produced light are individually detected. Two types of the visible light detectors are supported: Photo-Multiplier tubes (PMT) and Multi-Pixel Photon Counters (MPPC/SiPM). Energy deposition studies in the sensitive part of the detectors are carried out. [View on GitHub](#).

## TLIST Processor

Software is designed to process two-dimensional energy spectra and output one-dimensional coincidence broadened Doppler spectrum. A background fitting and subtraction technique is developed and implemented. [View on GitHub](#).

## SW Calculator

The program calculates S and W parameters of the 511 keV peak of the annihilation radiation. The software estimates the values of the binding electron energies by fitting the CDB spectrum with contributions from e<sup>+</sup> annihilation on electrons with different states and wavefunctions. [View on GitHub](#).

## RooPositron

A flexible terminal-based positron lifetime fitting software. GUI is in progress. The software supports deconvolution of lifetime spectra into the conventional multiexponential model as well as trapping model. Integration of custom fitting models. [View on GitHub](#).

# Conferences

## 18th International Conference on Positron Annihilation (ICPA-18)

Aug 2018

Orlando, FL, USA

Oral talk “Positions and Ps in Al<sub>2</sub>O<sub>3</sub> Nanopowders”.

## International Workshop on Physics with Positrons (JPos17)

Sept 2017

Jefferson Lab, Newport News, VA, USA

Poster “A routine of background subtraction from two-dimensional Doppler broadened spectra”.

## 12th International Workshop on Positron and Positronium Chemistry (PPC12)

Sept 2017

Maria Curie-Skłodowska University, Lublin, Poland

Poster “Developing new routine for processing two-dimensional coincidence Doppler energy spectra”.

#### **Ohio Photochemical Society Meeting (Oops)**

May 2017

*Maumee Bay Lodge & Conference Center, Maumee, OH, USA*

Poster “Developing new routine for background subtraction in two-dimensional coincidence Doppler broadening spectroscopy”.

#### **58<sup>th</sup> Electronic Materials Conference (EMC)**

Jun 2016

*University of Delaware, Newark, DE, USA*

Oral talk “High-Sensitivity Measurements of Defects in ZnO by Means of Digital Coincidence Doppler Broadening of Positron Annihilation Spectroscopy”.

#### **Annual Spring Meeting of the APS Ohio-Region**

Apr 2016

*University of Delaware, Newark, DE, USA*

Oral talk “Identification of chemical environment of defects in ZnO by means of digital coincidence Doppler broadening of positron annihilation radiation”.

#### **Ohio Inorganic Weekend**

Nov 2015

*Bowling Green State University, OH, USA*

Poster “Approaching Structural Defect Characterization and their Chemical Identification by Means of Coincidence Doppler Broadening of Annihilation Radiation”

#### **41<sup>st</sup> Polish Seminar on Positron Annihilation (PSPA-13)**

Sep 2013

*Maria Curie-Skłodowska University, Lublin, Poland*

Oral talk “Application of positron spectroscopy for detection of nanostructures in alcohol–aqueous mixtures”.

## **Scientific associations**

American Physical Society (since 2016)

The Ohio Academy of Science (since 2016)

## **Professional networks**

- Find examples of my [code on GitHub](#) (50+ repositories).
- Check out my design [portfolio on Dribbble](#) (50+ shots).
- Discover my professional contacts [on LinkedIn](#) (230+ connections).
- Skim through the list of my [publications on Google Scholar](#) (190+ citations).
- Get familiar with my [scientific career on ResearchGate](#).

## **Interests**

- Linux and open-source software. Hosting an [open-source project aimed at keyboard remapping](#) under Linux (over 250 stars on GitHub).
- Working on cars and motorcycles.
- Snowboarding and rollerblading.